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C.I.F. A29 507 456

Test report No:
NIE: 67003RAN.010

Assessment report
RF EXPOSURE REPORT ACCORDING TO
FCC 47 CFR Part 2.1091; FCC 47 CFR Part 1.1307
FCC 47 CFR Part 1.1310

(*) Identification of item under evaluation	Telematic control unit with wireless technologies, used in automotive industry.
(*) Trademark	VW AG
(*) Model and /or type reference	TKCMOD12N00, TKCMOD12E00, TKCMOD11000, TKCMOD12C00, TKCMOD12J00, TKCMOD12R00, TKCMOD12T00 and TKCMOD13C00
(*) Other identification of the product	IMEI TAC : 35194028 HW version: C2.3, SW Version: X152 FCC ID: T8GCONMOD Contains FCC ID: LHJ-FE5NA0020 IC: 6434A-CONMOD Contains IC: 2807E-FE5NA0020
(*) Features	GSM, UMTS, LTE, 5G, GNSS, Wi-Fi, BTLE, BT_EDR
(*) Manufacturer	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16; 76307 KARLSBAD GERMANY
Test method requested, standard	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices. FCC 47 CFR Part 1.1307: Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared. FCC 47 CFR Part 1.1310: Radiofrequency radiation exposure limits.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager  2023.01.18 15:17:29 +01'00'
Date of issue	2023-01-17
Report template No	FAN36_02 (*) "Data provided by the client"

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Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item under evaluation", "Trademark", "Model and/or type reference", “General description of the device”, “Other identification of the product”).
2. Maximum output power, maximum antenna gain and use distance information.
3. The device under evaluation consists of a telematics control unit with wireless technologies.
4. Derived model not tested. These models have been declared by the supplier of the sample as being the same as the model under test.

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HARMAN AUTOMOTIVE DIVISION
HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
BECKER-GOERING-STRASSE 16
76307 KARLSBAD, GERMANY

HARMAN
A SAMSUNG COMPANY

Declaration of similarity

To whom it may concern,

We, **Harman Becker Automotive Systems GmbH**, located in **Becker-Goering-Str. 16; 76307 Karlsbad, Germany**

Hereby declare that the following units: TKCMOD12E00, TKCMOD12N00, TKCMOD11000, TKCMOD12C00, TKCMOD12J00, TKCMOD12R00, TKCMOD12T00 and TKCMOD13C00

have integrated the same BT/Wifi chipset.

The different naming comes from country specific, features enabled or network access device type.

Targeted countries	Product Name	Type	NAD-HW	GNSS	Bluetooth WLAN	NAD Services	CV2X
Rest of the world (offline variant)	TKCMOD11000	V046	EU	x	x		
EU + some other countries	TKCMOD12E00	V037, V042, V043, V044, V049	EU	x	x	x	
Canada/Mexico/USA	TKCMOD12N00	V038, V039, V047	NA	x	x	x	
China (without CV2X)	TKCMOD12C00	V105	CN	x	x	x	
Japan	TKCMOD12J00	V045	RW	x	x	x	
Armenia/Belarus/Kazakhstan/Russia/Uzbekistan	TKCMOD12R00	V048	EU	x	x	x	
Turkey	TKCMOD12T00	V040	EU	x	x	x	
China (with CV2X)	TKCMOD13C00	V106	CN	x	x	x	x

This declaration is intended to be included in the test reports where applies

Regards

HARMAN AUTOMOTIVE DIVISION
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Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH

BECKER-GOERING-STR. 16; 76307 KARLSBAD GERMANY

Document history

Report number	Date	Description
67003RAN.010	2023-01-17	First release

Appendix A: FCC RF Exposure assessment result

General description of the device under evaluation

The device is a Telematics control unit with wireless technologies, used in automotive, equipped with one modem, OEM. This unit was designed for automotive usage and contains the following features: GSM, UMTS, LTE, 5G, GNSS, Wifi (a, b, g, n, ac), Bluetooth Low Energy (BTLE) and Bluetooth EDR.

The equipment supports several antennas that can be used for transmission. It supports different configurations in which different antennas can be used for different purposes and transmit simultaneously.

Antenna supported features and minimum installation distances declared by the manufacturer are:

Antenna	Tx - Bands	Position on vehicle	Installation distance (mm)
Shark fin antenna “LTE1” (Main cellular antenna)	GSM 850/1900 WCDMA II/IV/V LTE 2/4/5/7/12/13/14/17/25/26/41/66/71 5G n2/n5/n7/n66/n71	Car roof	> 19.375mm
Shark fin antenna “LTE2” (Backup/e-call cellular antenna) *(Only for Backup/e-call mode)	n41/n77/n78 *(GSM 850/1900, WCDMA II/IV/V)		
Shark fin antenna “BTLE”	Bluetooth LE		
Bumper “LTE3” *(Additional Backup/e-call cellular antenna) *(Only for Backup/e-call mode)	Only Rx *(GSM 850/1900, WCDMA II/IV/V)	Rear bumper	> 20cm
Internal Backup antenna	GSM 850/1900 WCDMA II/IV/V	Trunk	> 20cm
“BT_WLAN1”	WLAN 2.4GHz	Rear mirror bracket	> 20cm
“BT_WLAN2”	Bluetooth EDR 2.4GHz WLAN 5GHz	C/D pilar/frame window backside	> 19mm

Table 1: Antenna specifications and location.

In order to cover all carlines installations, the attenuation of the installation cable, which will depend on the cable length, was not taken into account to assess a more conservative worst-case condition.

SAR testing according to IEEE Std 1528™-2013 have been performed into DEKRA Testing and Certification, S.A.U. test report num. 67003RAN.009 for the worst-case installation distances between all carlines for the antennas that could be installed closer than 20 cm to the nearest passenger.

Antennas installed more than 20 cm away from any nearby passenger, Bumper “LTE3”, “Internal backup” and “BT_WLAN1” antennas, will be assessed according to FCC 47 CFR Part 2.1091 at a conservative evaluation distance of 30 cm.

The equipment specifications for each supported technology transmitted for these antennas are:

Technology / Mode	Band	Frequency (MHz)	Maximum Conducted Output Power (dBm)	Duty Cycle (%)	Time Averaged Conducted Power (dBm)	LTE3 Antenna Max. Peak gain (dBi)	Internal Antenna Max. Peak gain (dBi)	BT WLAN1 Antenna Max. Peak gain (dBi)	Maximum Averaged E.R.P (dBm)	Maximum Averaged E.R.P (mW)
GSM	850	824 - 849	34.00	12.50	24.97	4.50	1.80	-	27.32	539.40
GPRS 1TX	850	824 - 849	34.00	12.50	24.97	4.50	1.80	-	27.32	539.40
GPRS 2TX	850	824 - 849	34.00	25.00	27.98	4.50	1.80	-	30.33	1078.80
GPRS 3TX	850	824 - 849	34.00	37.50	29.74	4.50	1.80	-	32.09	1618.20
GPRS 4TX	850	824 - 849	34.00	50.00	30.99	4.50	1.80	-	33.34	2157.60
GSM	1900	1850 - 1910	31.00	12.50	21.97	6.50	-0.63	-	26.32	428.46
GPRS 1TX	1900	1850 - 1910	31.00	12.50	21.97	6.50	-0.63	-	26.32	428.46
GPRS 2TX	1900	1850 - 1910	31.00	25.00	24.98	6.50	-0.63	-	29.33	856.92
GPRS 3TX	1900	1850 - 1910	31.00	37.50	26.74	6.50	-0.63	-	31.09	1285.38
GPRS 4TX	1900	1850 - 1910	31.00	50.00	27.99	6.50	-0.63	-	32.34	1713.84
UMTS	II	1850 - 1910	25.00	100.00	25.00	6.50	-0.63	-	29.35	860.99
UMTS	IV	1710 - 1755	25.00	100.00	25.00	6.50	1.44	-	29.35	860.99
UMTS	V	824 - 849	25.00	100.00	25.00	4.50	1.80	-	27.35	543.25
802.11b/g/n	2.4 GHz	2412 - 2484	9.90	100.00	9.90	-	-	0.11	11.56	14.32

Table 2: Equipment specifications

Evaluation Results

Technology / Mode	Band	Frequency (MHz)	Distance (cm)	Power density (mW/cm²)	FCC General Population Limit (mW/cm²)	Verdict
GSM/GPRS	850	824 - 849	30.00	0.31	0.55	Pass
GSM/GPRS	1900	1850 - 1910	30.00	0.25	1.00	Pass
UMTS	II	1850 - 1910	30.00	0.12	1.00	Pass
UMTS	IV	1710 - 1755	30.00	0.12	1.00	Pass
UMTS	V	824 - 849	30.00	0.08	0.55	Pass
802.11b/g/n	2.4 GHz	2412 - 2484	30.00	0.00208	1.00	Pass

Table 3: FCC Evaluation Results

The computed value(s) are below the limit(s), so these modes meet the requirements stated in FCC 47 CFR Part 1.1307.

Simultaneous transmission assessment:

The device is able to transmit Cellular, WLAN and Bluetooth simultaneously, using different antenna combination:

Simultaneous transmission combination	Antennas	Applicable Evaluation Limit	S_i/Lim_i ratio	Result (∑ of evaluated ratios)	Verdict (∑ ≤ 1)
1	Shark fin antenna (“LTE1/LTE2/BTLE”)	SAR limit	0.70*	0.797	Pass
	“BT_WLAN1”	RF Exp limit	0.002		
	“BT_WLAN2”	SAR limit	0.095*		
2	Bumper “LTE3”	RF Exp limit	0.56	0.657	Pass
	“BT_WLAN1”	RF Exp limit	0.002		
	“BT_WLAN2”	SAR limit	0.095*		

Table 4: Simultaneous transmission assessment result and verdict

*Note: Maximum SAR values used for the simultaneous transmission assessment are stated into DEKRA Testing and Certification, S.A.U. test report num. 67003RAN.009.

Appendix B: FCC RF Exposure information

RF Exposure determination of exemption

According to FCC 47 CFR §1.1307 (b)(3) Determination of exemption:

(i) For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2), a single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by:

$$P_{th}\,(\text{mW}) = \begin{cases} ERP_{20\,cm}(d/20\,\text{cm})^{x} & d \le 20\,\text{cm} \\ ERP_{20\,cm} & 20\,\text{cm} < d \le 40\,\text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\,cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\,cm}\,(\text{mW}) = \begin{cases} 2040f & 0.3\,\text{GHz} \le f < 1.5\,\text{GHz} \\ 3060 & 1.5\,\text{GHz} \le f \le 6\,\text{GHz} \end{cases}$$

d = the separation distance (cm);

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

TABLE 1 TO §1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

(ii) For multiple RF sources: Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for Pth, including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

Pi = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

Pth,i = the exemption threshold power (Pth) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.

ERPj = the ERP of fixed, mobile, or portable RF source j.

ERPth,j = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

Evaluated,k = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limit,k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from §1.1310 of this chapter.

RF Exposure evaluation

Limits for Maximum Permissible Exposure (MPE) for RF sources are defined in FCC 47 CFR "§1.1310 Radiation Exposure limits, paragraph (e)":

TABLE 1 TO §1.1310(E)(1)—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*(100)	≤6
3.0-30	1842/f	4.89/f	*($900/f^2$)	<6
30-300	61.4	0.163	1.0	<6
300-1,500			f/300	<6
1,500-100,000			5	<6
(ii) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	<30
1.34-30	824/f	2.19/f	*($180/f^2$)	<30
30-300	27.5	0.073	0.2	<30
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

f = frequency in MHz. * = Plane-wave equivalent power density.

Each supported transmission technology will be evaluated to determine if it is in compliance with limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

In order to perform the assessment, the following equations have been used for the calculations; these equations are accurate in the far-field of an antenna and will over-predict power density in the near field, where they could be used for making a "worst-case" or conservative prediction:

Power density: $S[mW/cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\Pi R[cm]^2}$

Where:

S = power density

$P_{E.I.R.P.}$ = Equivalent isotropically radiated power

R = distance to the center of radiation of the antenna (evaluation distance)

$P_{E.I.R.P.}$ = $P_T + G_T - L_C$

Where:

P_T= transmitter output power (including tune-up tolerance)

G_T= gain of the transmitting antenna

L_C = signal attenuation in the connecting cable between the transmitter and the antenna if applicable